

## Retrospect

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### SURGERY OF THE PERIPHERAL NERVES

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**T**HE statement can probably be made without challenge, that no chapter of surgery has aroused greater interest in the past five years—to judge by the mass of literature that has appeared—than that dealing with injuries of the peripheral nerves.

Pre-war text-books devoted pages to the description of oper

ative methods, based on observations necessarily limited, upon which the accumulating evidence of the war results has been brought to bear. The final chapter is not yet written: another two years at least must pass before the reports appear which commissions in the various belligerent countries are preparing, and we must await their final summing up. But we have even now a wealth of material from which to form conclusions, and there is coming to be in the main a striking unanimity of view among those best qualified to judge.

The majority of nerve wounds do not call for operative interference. Tinel believes that 60 to 70 per cent. of nerves which show initial evidence of injury are but slightly damaged and are capable of spontaneous regeneration. It is in the cases which fail to show this improvement that the problem arises as to when operation should be undertaken.

Tinel's view is that the diagnosis of a complete interruption does not necessarily mean intervention. One must have evidence of the absence of regeneration, or of defective regeneration—a certainty that regeneration is not taking place or is progressing badly. It is scarcely possible to establish this certainty in less than from two to four months after wounding. He argues from successes met with after a year that early intervention is not indispensable, but expresses the view that early suture is followed by more rapid regeneration. Alexander, on the contrary, working at Alder Hey (quoted by Frazier) maintains that cases sutured within four months of the injury do not do as well as those sutured after the sixth month, probably because degeneration is not complete in the peripheral segment.

While operation must necessarily be delayed by the presence of sepsis, and postponed because of suppurating wounds, and stiffness of joints, necessitating the treatment of infection and the freeing and developing of the muscles, Sir Robert Jones, whose experience has been so wide, advocates exploring with the least possible delay, not because the chances of regeneration of the nerve are lessened, but because of the impairment of muscle power by a chronic myositis. A contused or compressed nerve will early show signs of recovery. In cases which do not spontaneously recover in a month or two it is usually a mistake to await regeneration of the nerve, and an exploratory operation should be undertaken.

Sir Harold Styles writing on this point says, "Increased experience has convinced me that we often delay too long in operating.

We are justified in delaying if there is definite evidence that improvement is taking place, and this is more likely to happen if the nerve has been contused as a result of a fracture or if the symptoms are due to the pressure of callus. In such cases the improvement is progressive and often ends in complete recovery. In cases, however, where the nerve has been directly injured by a bullet or a piece of shrapnel, it is, I think, a mistake to wait, although the lesion may be only partial. Many of these partial lesions are attended with severe pain, with aggravated trophic disturbances and with cicatricial or reflex contractures. In such cases valuable time is wasted in waiting for a recovery, which in the end is only very partial. If the wound has been healed for a few weeks there is little fear of trouble arising from the lighting up of latent mischief. The operation can do no harm, the wound is healed in a fortnight, and the exploration enables us to ascertain the exact nature of the lesion. The pain, the trophic changes, the reflex spasm, and the contractures often rapidly disappear. In short the operation will not only expedite the recovery but will at the same time render it more nearly complete."

Frazier analyzing results to date in the American army, advocates waiting for three months after the healing of the wound. This usually comes to mean six months after wounding, and allows ample time for spontaneous recovery, if it is to occur. "If at this time there are no signs of spontaneous recovery, on the one hand, and there is substantial evidence of a complete nerve interruption, whether or not this is interpreted as an anatomical division or a central neuroma, there are no grounds for further delay. One must not be deceived by the action of supplemental muscles which may compensate for the paralyzed muscles, as in one instance I recall when the war surgeon reported to me six months after the injury that a patient with a complete median and ulnar paralysis could flex the wrist, and asked to have the operation postponed. An examination revealed the fact that the patient had learned how to flex the wrist with the short extensors of the thumb."

Frazier emphasises the fact that it is impossible to distinguish with certainty by any single sign or syndrome whether we are dealing with complete and transitory block or a complete anatomical division, though in the majority of cases a careful examination of the motor, sensory, and electrical disturbance foretells the character of the lesion. Thus in a series of explored cases the following were the findings:

	Complete Motor Paralysis	Complete Sensory Paralysis	Complete Reaction of Degeneration
Compression.....	45 per cent.	15 per cent.	0 per cent.
Neuroma in continuity.....	74 per cent.	33 per cent.	16.5 per cent.
Complete anatomical interruption.	100 per cent.	86 per cent.	85 per cent.

Benisty working in La Salpêtrière under Pierre Marie, drawing inferences from a series of 150 operative cases, comes to these conclusions: "We are able to state definitely that an exploratory incision in nerve wounds is quite harmless when the surgeon is sure of his technique, conducts the operation with prudence and despatch and insures absolute asepsis. When clinical examination reveals persistence of the *signs of a severe lesion*, the fourth month should not be allowed to elapse before interfering."

#### METHODS OF OPERATION

As to the actual conduct of the operation, few will disagree with Styles in his emphasis on the following practical points; a thorough knowledge of anatomy on the part of the operator, who will conserve branches by knowing where to expect them; clean decisive cutting with a sharp knife; ample assistance. He advises against the use of a tourniquet, no doubt wisely, as the tendency to subsequent oozing is thereby lessened, and the vessels serve as a good guide to the nerve and its branches. Most operators advise approach to the nerve through normal tissue above and below the lesion excising the scar tissue. All unnecessary trauma to the nerve is avoided. When the nerve sheath is found intact and a response to weak faradism is obtained, close the wound without interference (Jones). Neurolysis or freeing is permissible when it restores a mobile, free and supple nerve with no obstruction in the centre (Tinel). This is indicated in compression, even if severe and extensive (Delageniere), gives excellent results in simple cases of constriction by a fibrous band, in evident pressure from callus, from a bone spicule, or from aneurism (Frazier). Do a neurolysis if the nerve responds promptly to faradic current (Frazier); an exsection if faradic response is feeble (Styles). Neurolysis is ineffective in severe lesions, in cicatricial nerve keloid and in exuberant neuromata (Tinel, Delageniere).

Frazier admits the difficulty of deciding between liberation and resection in certain cases of sclerosis or fibrosis of the nerve. He advocates a resection of spindle-shaped neuroma if after sufficient time has elapsed, arbitrarily given as six months, no response is obtained to faradism. With this Joyce disagrees, who advises a neurolysis capsulectomy first, with resection later if this fails.

Delageniere is not on the whole enthusiastic about neurolysis. From a series of 113 of these operations it has seemed to him that the procedure does not on the whole yield results superior to non-intervention. If in doubt Styles favours exsection, provided end-to-end approximation can be secured, and Tinel's much quoted dictum that "a good suture is better than a bad liberation" puts the truth in a nutshell.

As to the benefits of resection and suture when end-to-end approximation can be obtained there is no doubt. End-to-end suture is the method of choice when there is complete interruption with no regeneration: to quote Tinel, "It is the only way." The older methods advocated of turning down flaps find no favour. The prime requisite is the presence of healthy fasciculi free from the grasp of connective tissue. Slice after slice of the divided ends are removed until this is obtained. As to the actual technique of suture the advice given in a twenty year old edition of Rose and Carless holds good to-day. Suture is "best accomplished by using a domestic sewing needle without cutting edges . . . and the finest chromicized catgut. One or more stitches should pass through the nerve and the rest merely through the sheath. Absolute asepsis is essential in order to obtain satisfactory results." While a few operators prefer silk or linen, catgut undoubtedly holds pre-eminence to-day. Care must be exercised to avoid torsion, and crushing of the ends one upon the other must be guarded against.

In many cases it is surprising how end-to-end approximation can be obtained even where the removal of considerable length of nerve is required, by such devices as altering the position of joints; stretching of the nerves (this while the bulbs are still attached to lessen trauma to the freshly cut ends); transposition of the nerve and free exposure. Styles, for instance, does not hesitate to expose the ulnar nerve from the shoulder to the wrist in order to effect end-to-end suture.

A most useful method which developed during the later years of the war is the two-stage suture, as for instance in the case of a median injury near the elbow, in which the uncut bulbs are sutured

together with the forearm in flexion. By gradual extension of the elbow the nerve is stretched, and after the interval of a few weeks is again cut down upon and an end-to-end suture accomplished. This method is full of promise.

In 1907 Murphy described a method of wrapping the suture ends with fascia which he warmly advocated as preventing the invasion of connective tissue from the sides. This method was much practised early in the war but has been largely abandoned. The employment of calves' arteries, vein, cargile membrane, or fat for this purpose has also fallen into disuse. These all tend to throttle the nerve. The best bed is an intermuscular plane, or, where there is extensive cicatrization the nerve may be transplanted to a bed between the deep and superficial fascia (Frazier).

It was to repair large defects that the various operations were devised which occupied pages of the pre-war text-books; various methods of nerve transplantation, autogenous, homogenous, and heterogenous; neuroplasty, the so-called flap methods; suture à distance; tubulizations; resection of the bone; nerve anastomoses.

Nerve transplantation has been on a sound experimental basis for years, and high hopes have been held out at times for its usefulness. A large number of autogenous grafts have been done during the war, using one or more strands from a sensory nerve to bridge the defect. Moynihan's conclusions are that nerve grafting is of little value. Tinel is noncommittal. André Thomas concludes that grafting should only be resorted to when no other measure is possible. He quotes Gosset's results, where out of a large number of cases there were but two partial recoveries. Frazier concurs in stating an autograft is warranted only as a last resort. Rawling writes, "Grafting, implantation, etc., are comparatively useless." On the other hand Deleganiere reports three cases as complete successes. Jocelyn Swan had motor recovery following nerve grafts and advises against a condemnation of the method, with which Joyce in a carefully prepared article agrees. We must await the report of the commissions on this vexed question, meanwhile bearing in mind the emphatic words of Sir Robert Jones, who in quoting the unpublished report of the British Commission, states that in a large number of cases there has not been found one case of complete recovery, and but very few partial recoveries. Most cases, he writes, are complete failures.

Little has been written on homografts, because few of these have been done, but one looks in vain for any words of praise.

Burghard, in his system (1914), describes at length the various methods of "nerve-bridging", and concludes that as a rule the choice will be made between the heteroplastic form of the plastic methods, or one of the transplantation methods, either catgut or a nerve from one of the lower animals being made use of. Binnie, in 1916, writes: "The favourite method of bridging gaps is by means of several strands of chromicized catgut (distance sutures)." Tinel's reference to this procedure is that pseudo graftings by interposition between the nerve segments of fragments of aponeurotic sheaths of catgut threads to serve as conducting wires are wholly illogical and inevitably condemned to failure; there is nothing but nerve tissue that can serve as a conductor for regenerating axis-cylinders. Frazier writing on suture à distance, says he knows of no success in human surgery. In 1916, Dean Lewis and Kirk reported some very interesting experimental work on dogs in which they established regeneration across considerable gaps between ends of divided nerve trunks, which were surrounded by autogenous fascial tubes used essentially as a conducting tunnel, expressing the hope that the method would prove applicable in the human, but conceding the difficulty of drawing conclusions regarding the re-establishment of function in animals, as in dogs nerve repair takes place readily, even when no attempts at repair are made. Recently Platt of Manchester has presented a valuable paper reporting fifteen cases of autogenous graft with fascia! tubulization, and ten cases of fascial tubulization alone—all in the human. The result in every case was identical—a complete absence of any clinical sign of recovery.

The other methods formerly advocated, flap methods, and various forms of nerve anastomosis have few advocates to-day. One possible exception is in the type of case reported by Joyce, where a double lateral implantation of the ulnar into the median was done, with some motor and sensory recovery in the ulnar after twenty-four months; but at best recovery is slow and uncertain.

After care has received much emphasis; massage, galvanism, and careful splinting to maintain the paralyzed muscles in a position of relaxation. Perhaps the greatest of these is the maintenance of relaxation. Re-education must be undertaken as early as possible. For recovering cases purposeful movements, as in curative workshops, are of prime importance in the restoration of function. André Thomas' remarks are worthy of emphasis. "All orthopædic apparatus useful during the period of complete paralysis becomes frequently harmful during the period of restora-

tion As soon as the mobility of the organ returns it is advisable to use orthopedic apparatus as little as possible."

The prognosis varies to some extent with the individual nerves. The musculo-spiral has the best reputation. Regeneration in the ulnar is usually poor as regards the intrinsic muscles of the hand. It has been suggested that this is due to a distortion of the nerve pattern (Gwynne Williams), to the difficulty of keeping the small muscles relaxed or to some inherent property of the muscles themselves due to their highly complex movements (Joyce).

The results of nerve operation have been much questioned. On this point Tinel writes: "To us there does not appear to be any doubt at all on the matter. Nerve suture practised under favourable conditions almost invariably succeeds" He estimates at from 12 to 15 the percentage of failure in all cases. One must especially guard against impatience in foretelling failure, for nerve growth at best proceeds with extreme deliberation. I believe this optimism to be shared by those who have had the widest experience.

## DIURESIS AND THE CAFFEIN GROUP OF DIURETICS

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**T**HE normal process of urine formation in the higher animals is a combination of filtration and active secretion. The water and salt are passed through the kidney chiefly by a process of filtration or osmosis, while the urea and nitrogenous waste products are actively secreted by the cells which line the renal tubules. During a period of diuresis the main increase is in the salt and water constituents of the urine, and some authorities have claimed that an increased rate of filtration is the only essential actor in the production of a diuresis, no matter whether it arises from an increased water intake or from the action of specific drugs.